All the contamination monitoring results showed that there is no contamination in the floor surface, on the conditioned drums or DSRS stored inside NRWSF. These results show that the operation of the storage facility is safe for the environment, public and employes working in Albanian National Radioactive Waste Storage Facility.

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Evaluation of a ^{137}Cs radioactive source activity utilized in oil-welling in Albania

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Abstract

The Institute of Applied Nuclear Physics (IANP) is responsible for the national management of radioactive waste and disused sealed radioactive sources (DSRS) in Albania. It collaborates with public and private entities to ensure the safe transport and storage of radioactive materials.

This study outlines the procedure used to evaluate the total activity of two ^{137}Cs sources with unknown activity. In 2018, IANP received five DSRS from the Geophysical Service Center in Fier, following the closure of their temporary storage facility. Based on source certificates and on-site measurements, the inventory included: two ^{241}Am-Be sources (5 Ci each), one ^{137}Cs source (300 mCi), and two ^{137}Cs sources (52 mCi and 51 mCi, dated July 1978) stored together in a single container.

To verify whether both ^{137}Cs sources were encapsulated together, activity was estimated using point-source geometry. The measured total activity was 1.418 GBq, closely matching the decay-corrected certificate value of 1.528 GBq (as of March 2018), confirming the presence of both sources in one capsule.All sources were subsequently transferred to the National Radioactive Waste Storage Facility in Tirana.

1. Introduction

Since 1999, a dedicated Radioactive Waste Storage Facility (RWSF) has been established within the premises of the Institute of Applied Nuclear Physics (IANP) in Albania. This facility was constructed for the processing and temporary storage of radioactive waste and disused sealed radioactive sources (DSRS), in full compliance with both national and international Waste Acceptance Criteria (WAC) [2], [3]. In line with international best practices, the Radiation Protection Commission of Albania enforces the application of the IAEA Code of Conduct on the Safety and Security of Radioactive Sources and its supplementary guidance. This includes the obligation for importers of radioactive sources to ensure arrangements are in place for the eventual return of these sources to their manufacturers or to certified storage facilities abroad. In accordance with these regulations, a safety assessment of the RWSF is conducted periodically, evaluating its potential impacts on workers, the public, and the surrounding environment [1], [4], [6].

DSRS that cannot be re-exported or returned whether due to technical, regulatory, or logistical reasons are managed by IANP. In a recent case, an Albanian oil production company was required to transfer its inventory of radioactive sources to the national RWSF due to the expiration and non-renewal of its license for radioactive source storage. In response to the company's formal request, IANP undertook a full characterization of the stored DSRS and subsequently carried out the safe transport and transfer of all identified sources to its facility in Tirana.

2. Methods

Proper characterization of DSRS is essential for ensuring safe handling, storage, and, where applicable, disposal. The following procedure outlines the systematic steps to assess the physical, radiological, and safety parameters of each source prior to its acceptance at the Radioactive Waste Storage Facility (RWSF).

- **1. Initial Radiation Survey**
- **2. Contamination Assessment**
- **3. Identification and Labelling**
- **4. Documentation and Data Logging**

If activity and manufacture date are on the source label, we would calculate the activity at the present date using the radioactive decay equation.

$$A_t = A_o e^{-\lambda t}$$

Where:

- t = time (from the date of manufacturing to present date), A_t = activity at time t
- A_o = initial activity, λ = decay constant, $T_{1/2}$ = half live of the radionuclide

In this particular case, the device lacked an identification label, making it impossible to obtain source information from external markings. As a result, characterization of the radioactive source had to be carried out using appropriate radiation detection instruments [5], [7].

To identify the radionuclide, a portable gamma radiation detection device was used, an approach suitable for sources containing gamma-emitting radionuclides. This method allows for the non-destructive determination of the radionuclide based on its characteristic gamma energy peaks.

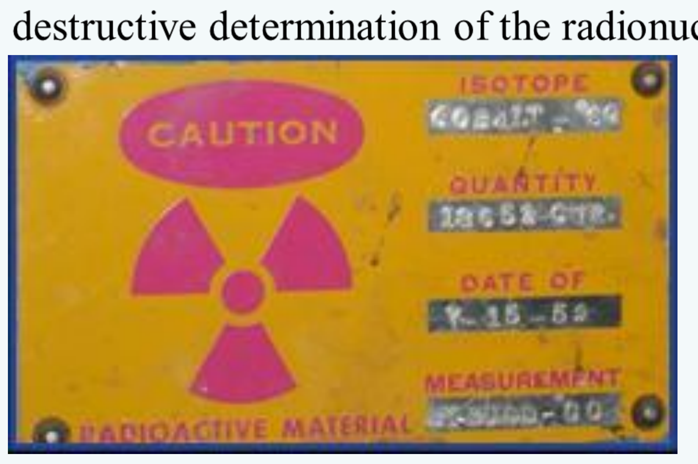

Figure Nr.1 Example of labels on the radioactive sources or devices

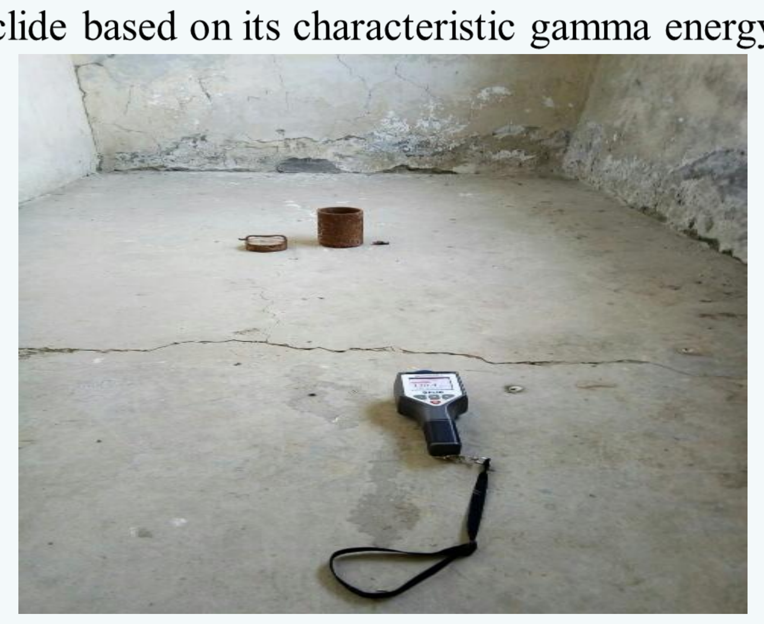

Figure Nr.2 Measurement of dose rate at 1 m distance.

Due to the presence of shielding, the measured dose rates were attenuated, resulting in relatively low radiation levels. Under these controlled conditions, it was safe to open the shielding cover and carefully remove the source. The activity of the source was then estimated by assuming a point-source geometry. The dose rate (DR) was measured at a distance of 1 meter (r) from the source, and the following formula was applied to calculate the estimated activity. $DR = \Gamma \times A / r^2$

Where:

DR – dose rate at a distance "r" from the source, expressed in mSv/h

Γ - Ambient dose equivalent rate, H*(10), produced at 1 meter by the radioactive source, expressed in $mSv.m^2/h.GBq$.

3. Results

Based on the available documentation and source certificates in possession of IANP, along with the on-site measurements conducted for verification, the inventory of radioactive sources included the following:

- Two Americium-Beryllium (^{241}Am-Be) neutron sources, each with an activity of 5 Ci
- One Cesium-137 (^{137}Cs) source with an initial activity of 300 mCi
- Two additional ^{137}Cs sources with activities of 52 mCi and 51 mCi, respectively
- One ^{137}Cs source of unknown activity

The two ^{137}Cs sources with activities of 52 mCi and 51 mCi were reported to be stored together within a single container. As such, these sources required joint characterization using the standard procedure described earlier for DSRS.

Following the contamination control protocol, the external surface of the source container was tested for radioactive leakage. The wipe test confirmed that there was no removable contamination, and the container was deemed safe for handling.

For dose rate measurements, the FLIR Identifinder-2 instrument was used. Measurements were taken at a distance of 1 meter from the source capsule. The recorded ambient dose equivalent rate was 130.5 µSv/h.

To estimate the combined activity of the two ^{137}Cs sources, the point-source geometry method was applied. Using the standard dose-to-activity conversion coefficient for Cesium-137, which is 0.092 $mSv \cdot m^2/h \cdot GBq$ the activity was calculated using the following formula nr 3 described above.

The resulting combined activity of the two ^{137}Cs sources was determined to be 1.418 GBq.

Following the characterization, all remaining radioactive sources were securely transferred into metal storage buckets, each appropriately labelled with source identification details. The sources were then safely transported to the National Radioactive Waste Storage Facility in Tirana, where they were placed into temporary storage, in accordance with regulatory procedures and safety standards [8].

4. Conclusions

A comparison was made between the activity calculated through direct measurement and the certified values indicated in the source documentation in order to verify the characterization results of the two co-located Cesium-137 (^{137}Cs) sources. The activity determined through field measurement was 1.418 GBq, while the combined activity listed in the certificates was 1.528 GBq (corresponding to 52 mCi and 51 mCi, respectively). The proximity between these values supports the conclusion that both ^{137}Cs sources were indeed encapsulated together within a single container.

Following this verification, the sources were securely transferred and are currently under temporary storage at the National Radioactive Waste Storage Facility in Tirana, Albania.

The Institute of Applied Nuclear Physics (IANP) serves as the central authority for the management and processing of disused and orphan radioactive sources within the country. In particular, IANP is the designated first responder in cases where unidentified or unauthorized radioactive materials are detected, including those identified at border crossings and customs points.

Albania has established radiation detection portals at key customs locations, which are actively monitored by the competent national authorities. These systems serve a critical role in ensuring the safety of both the public and customs personnel. The authorities are committed to maintaining and continuously improving these detection capabilities to respond effectively to potential radiological threats.

In the event of detection, IANP is responsible for source assessment, secure transportation, and integration of the material into the radioactive waste management system, as outlined in the national emergency response plan. All identified sources are transported to the storage facility under strict safety protocols.

The management of radioactive waste and DSRS is a dynamic process, requiring regular reviews and updates to programs, infrastructure, and safety practices. With anticipated growth in the use of radioactive sources in Albania, proactive planning is essential.

In this context, our current study supports the forecasted saturation of temporary storage facilities by 2040, reinforcing the need to identify and develop a permanent radioactive waste disposal solution. Such a permanent facility must be designed in accordance with International Atomic Energy Agency (IAEA) safety standards and guidelines, particularly for low- and intermediate-level radioactive waste disposal near the surface..

5. References

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